We claim:

1. A method of determining formation density in a cased hole environment using a logging tool having a gamma ray source, a long spacing detector, and a short spacing detector, comprising:

developing one or more cased hole calibration relationships that utilize differences between scattered gamma rays observed by short spacing detectors and scattered gamma rays observed by long spacing detectors to determine corrected formation density values, and

using said cased hole calibration relationships and scattered gamma ray measurements obtained by said long spacing detector and said short spacing detector to determine the formation density.

2. A method according to claim 1, wherein said long spacing detector is located between 13 and 24 inches (33-61 centimeters) from said gamma ray source.

3. A method according to claim 2, wherein said long spacing detector is located between 14 and 18 inches (36-46 centimeters) from said gamma ray source.

4. A method according to claim 1, wherein said short spacing detector is located between 5 and 12 inches (13-30 centimeters) from said gamma ray source.

5. A method according to claim 4, wherein said short spacing detector is located between 6 and 8 inches (15-20 centimeters) from said gamma ray source.

6. A method according to claim 1, wherein said logging tool further includes a backscatter detector located between said gamma ray source and said short spacing detector.

7. A method according to claim 1, wherein said gamma ray source comprises a Cesium-137 source.

8. A method according to claim 1, wherein different said calibration relationships are determined for different casing thicknesses and casing thickness is determined by one or more of: back calculated from planned casing weight; comparing count rates from low energy and high energy windows of a third (backscatter) detector positioned between said gamma ray source and said short spacing detector; and ultrasonic measurements.

9. A method according to claim 1, wherein different said calibration relationships are determined for different cement thicknesses and cement thickness is determined by one or more of: taking one half of the difference between the nominal borehole diameter (determined either from the size of the largest drill bit that passed through that portion of the borehole or from an open hole caliper log) and the outer diameter of the casing; multiplying the difference between the best estimate of the formation density and the estimate of the formation density derived solely from the long spacing detector by a constant and then dividing this product by the difference between the best estimate of the formation density and an estimate of the cement or annulus density; neutron measurements; and ultrasonic measurements.

10. A method according to claim 1, wherein different said calibration relationships are determined for different cement densities and cement density is determined by one or more of: utilizing the density of the cement pumped at the surface and ultrasonic measurements.

11. A method according to claim 1, wherein said scattered gamma ray measurements obtained by said long spacing detector and said short spacing detector are corrected for perturbations associated with completion hardware.

12. A method according to claim 11, wherein said correction is performed by identifying a region associated with said completion hardware and substituting for perturbed samples in this region an average of the values of closest good samples on either side of these perturbed samples.

13. A method according to claim 1, where said short spacing detector and said long spacing detector each have multiple energy windows and count rates from lower energy windows associated with said detectors are ignored or underweighted with respect to higher energy windows associated with said detectors.

14. A method according to claim 1, further comprising determining a maximum standoff distance been said logging tool and the formation.

15. A method according to claim 14, further comprising determining when the standoff distance between said logging tool and the formation exceeds said maximum standoff distance.

16. An article of manufacture, comprising:

a computer useable medium having a computer readable program code means embodied therein for determining formation density in a cased hole environment, the computer readable program code means in said article of manufacture comprising:

computer readable program means for determining formation density in a cased hole environment using one or more cased hole calibration relationships and measurements made by a logging tool having a gamma ray source, a long spacing detector, and a short spacing detector,.

17. A computerized well logging system for determining formation density in a cased hole environment, comprising:

a logging tool having a gamma ray source, a long spacing detector, and a short spacing detector;

a computing module and/or processing circuitry, connected to said logging tool, having means for calculating formation density from gamma ray scattering measurements obtained by said long spacing detector and gamma ray scattering measurements obtained by said short spacing detector using one or more cased hole calibration relationships.

18. A computerized well logging system according to claim 17 wherein said logging tool is suspended by a cable and a swivel allows said logging tool to rotate with respect to said cable.

19. A computerized well logging system according to claim 17, wherein said logging tool has a recommended open hole logging speed and a recommended cased hole logging speed and said recommended cased hole logging speed is at least two times slower than said recommended open hole logging speed.